

Chapter 1

PERSPECTIVE OF VALUE ENGINEERING (VE)

Introduction

The amount of money available for our country's defense is determined by the democratic processes by which we govern ourselves. Defense budgets are affected by the threat from our adversaries, our reaction to the threat, by the funds necessary for Government activities other than defense and finally by our skill in managing the resources entrusted to us for defense. Efficient utilization of these allotted resources has been a major management objective for many years. The quickening pace of technological advances and the increasing pressure of budgetary restraints have made it necessary to place even more emphasis on economy and efficiency within the Department of Defense (DoD).

DoD policy is to use VE to make a significant contribution toward greater economy in developing, acquiring, operating, and supporting the products necessary to fulfill its mission. The DoD VE program is intended to foster the use of value-oriented techniques across the entire spectrum of DoD activities.

VE is a fundamental approach which challenges everything and takes nothing for granted, including the necessity for a product or service. It is applicable to systems, equipment, facilities, procedures, methods, software, and supplies. It may be successfully introduced at any point in the life cycle of the product under consideration (see Chapter II). The following are some of the areas in which VE has been applied in the DoD:

- Construction
- Design or equipment modifications
- Equipment and logistics support
- Equipment maintenance
- Facilities, master plan, and concepts
- Hardware
- Manufacturing processes
- Material handling and transportation
- Packaging, packing, and preservation
- Procedures and reports
- Procurement and reprocurement
- Publications and manuals
- Quality assurance and reliability
- Salvage, rejected, or excess material
- Site preparation and adaptation
- Software (computer) programs and flow charts
- Specifications and drawings
- Technical and logistics data
- Technical requirements
- Testing, test equipment, and procedures
- Tooling
- Training

VE emerged from the industrial community. It has spread throughout private industry and within the DoD because of its ability to yield a large return on a relatively modest investment. It is an additional management **tool** to gain the desired results within the constraints of time and cost. To realize this potential, **VE** must be clearly understood and correctly applied. This chapter provides the perspective for the **VE** program in the DoD.

Historical Background

The **VE** concept is a by-product of material shortages during World War II. These shortages led to the creation of innovative material and design alternatives. It was found that the alternative approaches often worked as well, or better, and cost less. From this beginning an analytical discipline evolved - in private industry that was structured to challenge the proposed way of designing and acquiring things and to systematically search for less costly alternatives.

In 1957, the Navy's Bureau of Ships became the first DoD **activity** to establish a formal **VE** activity. It was called "value engineering" because it was staffed with general engineers, the most closely related position description available at that time. Although no longer exclusively the province of "**engineers**," the term "value engineering" has persisted as the title of the program.

The DoD established its **VE** program in 1963. It continues to have two distinct elements. The first is an in-house effort whereby **VE** is performed by DoD military and civilian personnel. The second is the program which was created to stimulate contractors to perform **VE** and to develop and submit value engineering change proposals (**VECPs**). Accepted **VECPs** change contract specifications, purchase descriptions, or statements of work that impose costly, nonessential requirements. An incentive is provided by giving the contractor a share in the savings that result from any approved change proposals submitted by the contractor and approved by the Government. An alternative, the program requirement clause, is used to pay a contractor for **VE** activities regardless of whether the purpose is submission of **VECPs** or some other cost reduction purpose.

With some few exceptions, it has been mandatory since June 1962 that **VE** provisions be included in most DoD contracts to encourage contractor **participation** and to realize the full benefits from cost reduction opportunities and innovations.

Prior to the development of the clause permitting contractors to share in the savings, a contractor who submitted a cost reduction change had the amount of his contract reduced by the total reduction. This usually reduced his profit by a proportional amount. There was, therefore, no "incentive to **submit** proposals to reduce cost. Now the **VE** clause allows a portion of the saving accruing to the Government to be returned to the contractor.

Unfortunately, there are still some Government personnel who believe that the **contractor is** paid twice or is unjustly rewarded. A close examination of the clauses, an understanding of the safeguards in the acquisition process, and some familiarization with the reasons for unnecessary costs should serve to correct this erroneous idea.

VE Defined

In the DoD, VE is defined as a systematic effort directed at analyzing the functional requirements of DoD systems, equipment, facilities, procedures, and supplies for the purpose of achieving the essential functions at the lowest total cost, consistent with the needed performance, safety, reliability, quality, and maintainability. Although there are numerous other published definitions of **VE**, most are merely minor variations of this definition. Value Engineering (**VE**) is the term used in this Handbook and by the DoD in its contracts. Terms such as value analysis, value management, value control, and others are considered synonymous. Some use them to differentiate the use of the value process by those who are not engineers. Thus, value analysis is sometimes used to describe a value program in a purchasing or acquisition **function**. The terms value control or value management are used by some to describe the application of value techniques to administrative and office procedures. There may be some subtle differences among these terms but the basic objectives and philosophy appear to be the same for all.. The DoD **VE** program encompasses all value-oriented activities.

VE is not centered on a specific category of the physical sciences. It incorporates available technologies as well as the principles of economics and business management into a specific procedure. Chapter V of this Handbook describes the generation of value proposals portion of this procedure. Marketing of value proposals is one of the most difficult segments of the VE process. Chapter VI of this Handbook is devoted solely to this topic.

VE utilizes the total resources available to an organization to achieve broad, top management objectives. Thus, **VE** is seen as a systematic and creative approach for increasing the "return on investment" (**ROI**) in components, weapon systems, facilities, and other products acquired and operated by the DoD.

Increased **ROI** for the DoD results from a combination of lower costs for acquisition, logistics, or operation while maintaining the necessary level of performance. It often results in capability for the same or a lower dollar expenditure. This viewpoint is consistent with statements of policy and regulations governing VE in the DoD, and serves to further describe the role of VE in the DoD. For industry, the benefits of **VE** include an acceptable **ROI**, increased profits, and improved competitive position.

Program Objective

The basic VE concept is that anything providing less than the performance required by the customer or user is not acceptable; anything providing more should be avoided unless there is no cost penalty.

The objective of VE in defense contracting is to reduce the Government's acquisition or ownership costs (operational costs, maintenance costs, training costs, etc.) while maintaining the necessary level of performance. This objective may be achieved by encouraging contractors to respond to the VE clauses in DoD contracts. These clauses invite or require contractors to initiate, develop, and submit cost-reduction proposals during performance of a contract that involve changes to contract requirements. The clauses require the Government to share with the contractor any cost reduction resulting from

a VECP. **VE** clauses in DoD contracts are not enough. The clauses merely permit contractors to question the value of government specifications, statements of work, and those requirements that contribute nothing (except cost) to the contract tasks or items being bought. The invitation must be accepted by the Government. Then both parties (Government and contractor) must work together to capture the actual benefits.

Fundamentals

A. Function

Function is defined as the specific purpose or use intended for something. It describes what must be achieved. For **VE** studies, the description of **function** is reduced to the simplest accurate expression. This is accomplished by employing only two words; an active verb and a quantifiable noun. "Support weight," "transmit torque," and "conduct current" are **typical** expressions of function. Note that each function is described in terms that are quantifiable and measurable.

B. Worth

Worth is the least expenditure required to provide an essential function and is established by comparison. (One method of approximating **worth** is by determining the cost of a functional equivalent.) Worth is not affected by the consequence of failure. (For example, if a bolt supporting a wing of an aircraft fails, the plane may crash. Nevertheless, the worth of the bolt is the lowest cost necessary to provide a reliable fastening, not the cost of a downed aircraft.)

C. cost

Cost is the total amount of funds required to acquire, utilize, and maintain the specified functions. For the seller, this is the total expense associated with the production of a product. For the DoD, the total cost includes not only the purchase price of the product but also the costs of introducing it into the DoD inventory, operating it, supporting it throughout its usable life and disposing of **it when** it no longer **serves** a useful, functional purpose. (Total cost also includes a proportionate share of the in-house expenditures for development, engineering, testing, spare parts, and various categories of overhead expense.)

D. Value

Value is the relationship of worth to cost in accordance with the user's (or customer's) needs and resources in a given situation. The ratio of worth to cost is the principal measure of value. Thus, a "value equation" may be used to derive a Value Index as follows:

$$\text{Value Index} = \frac{\text{Worth}}{\text{Cost}} = \frac{\text{Utility}}{\text{cost}}$$

Value may be increased by (1) improving the utility of something with no change in cost, (2) retaining the same utility for less cost, or (3) combining improved utility with a decrease in cost. Optimum value is achieved when all

utility criteria are met at the lowest overall cost. Although worth and cost can each be expressed in monetary units, value is a dimensionless expression of the relationship of these two.

E. Types of VE Recommendations

Within the defense environment there are two acronyms used for the recommendations resulting from VE efforts. They are:

1. Value Engineering Proposal (VEP). A VE recommendation originating and implemented solely within the Government, one which was originated by a contractor and may be implemented as a unilateral contractor action (i.e., a Class II change), or one which was originated by a contractor hired solely for the purpose of doing VE and implemented by the Government.

2. Value Engineering Change Proposal (VECP). A formal recommendation by a contractor requiring Government approval and which will require a change to the contract, specifications, purchase description, statement of work, etc., and result in a decrease in the overall cost to the Government. **VECPs** may be submitted by contractors having a **VE** clause included in their contract in accordance with the applicable acquisition regulation. Subcontractors may also submit **VECPs** to prime contractors in accordance with the terms of their contract. The current acquisition regulation directs contractors to include **VE** provisions in subcontracts (with certain limited exceptions) of \$100,000 or more. Spares contracts and subcontracts of \$25,000 or more must include a **VE** incentive (**VEI**) clause. (See Chapter III for a more complete discussion of contractual aspects.)

A Typical VE Program

A typical VE program is a defined set of policies and responsibilities which will ensure that **VE** discipline is integrated into all elements of an organization. An effective and sustained **VE** program will have:

- 0 Top management involvement to ensure implementation and continuing emphasis by middle management.
- 0 A key individual to manage the VE program. This individual should be well versed in VE principles, techniques, and appropriate acquisition regulations.
- 0 A "master plan" to insure that actions which may effectively contribute to a **successful** program are considered and acted upon.
- 0 VE objectives, policies, responsibilities, and reporting requirements firmly established and implemented.
- 0 The funds necessary for administrative and operating expenses such as testing and evaluating proposals.
- 0 A comprehensive training and orientation program, to acquaint Personnel with policies, procedures, and benefits.

- 0 "Crossfeed" mechanisms to communicate information about successful application to others who can benefit.

For defense industry programs, the following should also be included:

- 0 Close coordination with contract administration and marketing to ensure proper VE contractual participation and marketing follow-up.
- 0 Management attention to ensure that the VE discipline is used to earn additional income.

Although there are many other specific tasks required to ensure that VE achieves its full potential, the above form the foundation upon which the structure of a strong program may be built.

Opportunities for VE

Shortly after its program was established, the DoD conducted a study to determine the predominant sources of the opportunity for VE. The **objective** of the study was to determine the range and degree of application of VE. With the combined assistance of the three Military Departments, the Defense Supply Agency (now the Defense Logistics Agency), and the Society of American Value Engineers a review was conducted of 415 implemented VE changes which yielded total cost savings of \$106 million. This study identified seven factors which were responsible for about 95 percent of the savings. Predominant were excessive cost, additional design effort, advances in technology, and the questioning of specifications. It is important to note that these factors do not suggest that the original design efforts were substandard. The study also revealed that a single factor was rarely the basis for a VE action. The study findings are tabulated in Figure I-1.

FACTORS LEADING TO VE CHANGES

Percent of total actions	Percent of total savings	Factor	Definition
13.9	23.2	Advances in technology _____	Incorporation of new materials, components, techniques, or processes (advances in the state-of-the-art) not available at the time of the previous design effort.
23.1	22.2	Excessive cost _____	Prior design proved technically adequate, but subsequent cost analysis revealed excessive cost.
14.4	17.7	Questioning specifications	User's specifications were examined, questioned, determined to be inappropriate, out-of-date, or overspecified.
27.8	14.8	Additional design effort	Application of additional skills, ideas, and information available but not utilized, during previous design effort.
5.2	11.8	Change in user's needs _____	User's modification or redefinition of mission, function, or application of item.
6.8	4.0	Feedback from test/use _____	Design modification based on user tests or field experience suggesting that specified parameters governing previous design exaggerated.
4.6	3.8	Design deficiencies _____	Prior design proved inadequate in use (e.g. , was characterized by inadequate performance, excessive failure rates, or technical deficiency).
4.2	.25	Miscellaneous _____	Other factors not included in above.

Figure 1-1

Benefits of VE

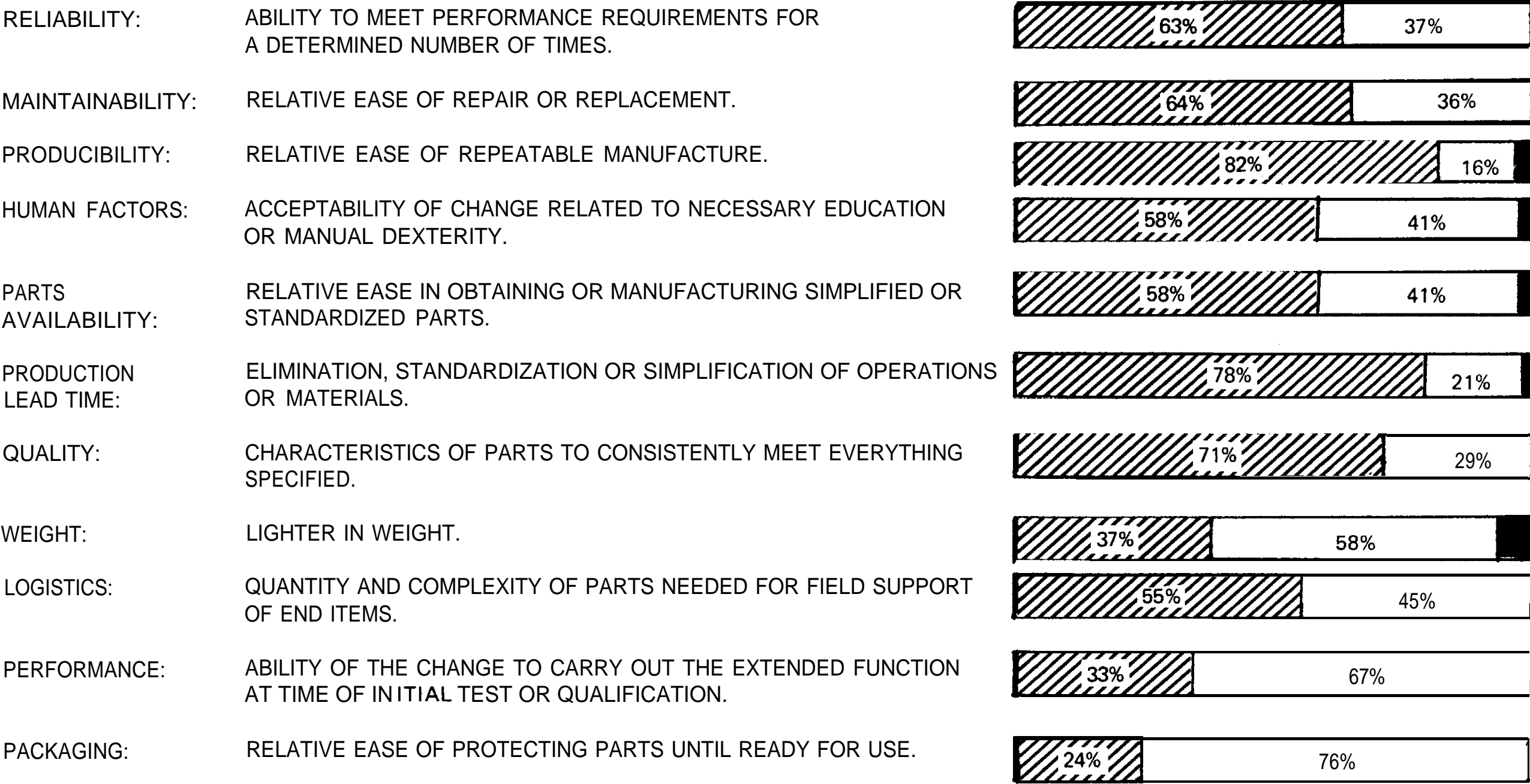
Benefits from the DoD VE program are significant. In-house savings of approximately a billion dollars a year are being reported. Reported savings from the contractor VECF program are approximately \$250 million, and are expected to increase. Benefits of this magnitude are noteworthy but do not tell the full story. As important are the use to which these funds are put. The dollars that are made available through VE savings may be reapplied within the program, command, or component to provide the means to support approved but previously unfunded requirements. The money stays with the activity that achieves the saving and rewards those who are deserving. It can provide needed funds which are generated internally by sound management activities.

For DoD contractors and subcontractors there are both direct and indirect advantages from the internal VE activities as well as from VECFs. The most obvious direct advantage is that the defense contractor shares in the cost savings that accrue from implementing VECFs. Therefore, it is a tool for increasing the contractor's profit through proposed changes in contract requirements. Changes may be proposed to contract specifications, purchase descriptions, or statements of work as long as they do not degrade essential quality, reliability, maintainability, or required performance of the item.

A major indirect advantage for contractors and subcontractors in addition to the savings on approved VECFs is an enhanced competitive position by producing required products at lower costs. An active program establishes a reputation as a cost-conscious producer. A reputation of this nature can be beneficial. For contracts that are negotiated, VE successes may be considered when determining the Government's fee objective for the contract. Thus a contractor with an active VE program might obtain a larger fee than a contractor without one, all other things being equal. The net result of successful contractor VE is an improved profit structure, while the Government acquires needed defense capability with a minimum expenditure of tax dollars.

VE also offers other **benefits**. For example, in an early assessment of the DoD VE program, the American Ordnance Association (now the American Defense Preparedness Association) **reported** the results of a survey it conducted at the request of the DoD. The objective was to determine the impact on certain factors other than cost. **This** analysis was conducted on a random sample of 124 VE changes (taken from a **total** population of 660 changes). The survey revealed that VE made significant contributions toward improving the measured characteristics. Another later but more extensive survey corroborated the earlier findings and also identified why VE yielded these benefits. The specific benefits and the relative frequency of their occurrence are shown in Figure I-2.

TOTAL VALUE ENGINEERING EFFECTIVENESS
SAMPLE OF 193 IMPLEMENTED CONTRACTOR VE CHANGES DRAWN FROM 2,627 CHANGES



SOURCE: Total Value Engineering Effectiveness, American Ordnance Association, Washington, D.C. 20006, August 1967, pg. 5 and 6.

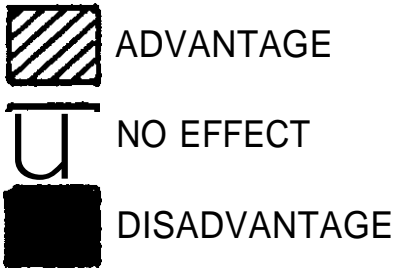


FIGURE 1-2

Thus, in addition to cost savings, VE often yields benefits such as: improved performance, relative ease of repair and replacement, repeatable manufacture, elimination of materials, standardization or simplification of operations, lighter weight, and improved use of resources.

VE in DoD Contracts

Specific VE contract provisions are contained in the Federal Acquisition Regulation (FAR) and the DoD FAR supplement. These publications specify DoD acquisition policies. Their provisions enable a contractor to recover a portion of the savings that result from initiative and ingenuity in identifying and successfully challenging nonessential contract terms and provisions. These clauses are intended to foster a climate of cooperation, and managed change to permit the Government to acquire better, lower-cost items. Chapter III. contains a detailed discussion of these contract clauses.

Summary

The Secretary of Defense has placed increased emphasis on limiting the overall expenditures of the DoD to the minimum necessary to achieve the capability to fulfill its mission. VE has become recognized as an effective contributor to this objective. It is an intensive review of requirements and the development of alternatives by the use of appropriate value techniques utilizing aspects of engineering, requirements analysis, the behavioral sciences, creativity, economic analysis, and the scientific method. Employed in an organized effort, it utilizes a systematic procedure for analyzing requirements and translating these into the most economical means of providing essential functions without impairing essential performance, reliability, quality, maintainability, and safety. There is no limit to the field in which VE may be applied. Its application can be considered at any point in the life cycle of a product. Experience has shown that the beneficial impact of VE is not limited to economic improvement. Significant improvements also occur in other attributes which are not always readily measurable in monetary terms.

A successful VE program requires top management involvement. Each functional, project or acquisition manager must cooperate and participate to ensure an effective program. Line management is both responsible for and benefits from VE.